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VALIDATING AND ENHANCING THE
CORPS OF ENGINEERS RESOURCE
AND MILITARY MANPOWER SYSTEM

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Executive Summary

VALIDATING AND ENHANCING THE CORPS OF ENGINEERS RESOURCE AND MILITARY MANPOWER SYSTEM

The Corps of Engineers Resource and Military Manpower System (CERAMMS) forecasts manpower and funding requirements for U.S. Army Corps of Engineers (USACE) military programs. It is the primary tool for managing Government manpower associated with the military construction program.

After 3 years of use, USACE wanted to validate the accuracy of CERAMMS estimates. This validation would also help get CERAMMS accepted as an official Army staffing standard. At the same time, USACE wanted to enhance CERAMMS so its manpower estimates could be matched to the functional codes used in developing Army Tables of Distribution and Allowances. Logistics Management Institute (LMI) was tasked to perform both of these activities.

We found CERAMMS to be valid at both the USACE and division levels. The total manpower requirement estimated by CERAMMS (based on actual workload) was within 9 percent of the 9,500 man-years utilized by USACE in 1988, and within 1 percent of the 8,700 man-years utilized by USACE in 1989. These results are particularly convincing in view of the significant changes in USACE military program and staffing levels during those years.

We also identified 38 functional Standard Work Center Codes, estimated manpower utilization coefficients by type of work for each code, and incorporated these codes and their coefficients into CERAMMS. Although USACE has some unique functions that are not well defined by the current set of codes, data collected from the field show that the resulting CERAMMS estimates accurately reflect the actual mix of manpower by major function at a typical USACE district.

We recommend that USACE seek U.S. Army Force Integration Support Agency recognition of CERAMMS as an official Army staffing standard. We further recommend that the enhanced CERAMMS model be used as the basis for reviewing existing manpower distributions at the division and district levels. The purpose of

these reviews would be to ensure the efficient use of limited USACE manpower resources and to identify where changes in staffing are needed. We believe such actions are necessary if USACE is to meet the management challenges that declining military construction budgets present.

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CHAPTER 1

INTRODUCTION

The Corps of Engineers Resource and Military Manpower System (CERAMMS) was used to forecast manpower and funding requirements for U.S. Army Corps of Engineers (USACE) military programs for fiscal years 1988, 1989, and 1990. CERAMMS applies statistical algorithms and management controls to detailed data on the expected level and mix of USACE military engineering and construction services.¹ A district-level version of CERAMMS is available, but divisions are not required to use CERAMMS when determining district manpower allocations. In Table 1-1, we present the codes used extensively in this report for USACE divisions.

The U.S. Army Force Integration Support Agency (USAFISA) required that CERAMMS be validated before it could be approved as an official Army staffing standard. USACE also wanted to enhance CERAMMS so its manpower estimates could be matched to functional Standard Work Center Codes (SWCCs). These codes are defined in *Army Functional Dictionary – Manpower*, Department of the Army Pamphlet 570-5, and are maintained by USAFISA. They are used in developing Army Tables of Distribution and Allowances (TDA).

Logistics Management Institute (LMI) was tasked to perform both of these activities. Our report is organized into four chapters and three appendices. Chapter 2 and Appendix A document the validation of CERAMMS manpower estimates. Chapter 3 and Appendices B and C describe the enhancement of CERAMMS to support functional disaggregation of USACE manpower estimates. Finally, Chapter 4 presents LMI's conclusions and recommendations.

¹The development and structure of CERAMMS are documented in LMI Report AR603R1, *Corps of Engineers Resource and Military Manpower System*, William Moore, Robert Salthouse, Robert Hutchinson, and Robert Crosslin, May 1987.

TABLE 1-1
USACE DIVISION CODE DEFINITIONS

Code	Division
EUD	European Division
HND	Huntsville Division
LMVD	Lower Mississippi Valley Division
MRD	Missouri River Division
NAD	North Atlantic Division
NCD	North Central Division
NED	New England Division
NPD	North Pacific Division
ORD	Ohio River Division
POD	Pacific Ocean Division
SAD	South Atlantic Division
SPD	South Pacific Division
SWD	South West Division

CHAPTER 2

CERAMMS VALIDATION

METHODOLOGY

Comparing the original CERAMMS manpower estimates to actual manpower utilization is not an appropriate validation methodology, since those estimates were based on expectations regarding future workload. If those future expectations were incorrect, the results would have also been incorrect regardless of the validity of CERAMMS itself. We therefore used actual – rather than expected – military design (engineering) and construction placement as inputs to CERAMMS, and then compared the resulting manpower estimates to actual manpower utilization. These comparisons were performed for fiscal years 1988 and 1989.

DESCRIPTION OF DATA

Our methodology required military design and construction placement data. Corps of Engineers Management Information System (COEMIS) data provided by districts and divisions in response to a data call were not used because design placement was not available and the responses were incomplete. Automated Management and Progress Reporting System (AMPRS) data collected electronically from USACE headquarters were not used because the placement totals differed significantly from comparable figures found elsewhere. We therefore obtained the necessary information from 3018C Reports generated by COEMIS for USACE headquarters.

Our methodology also required actual manpower utilization data. Because the detailed data we needed were not available from COEMIS or AMPRS, we sent out a data call to each district and division requesting military and civil works man-year allocations and utilizations by major function, as well as construction placement data (for corroborating purposes).

The data call responses were not complete for the North Atlantic, North Pacific, South Atlantic, South Pacific, and South West division offices. We therefore had to use CERAMMS allocations as a proxy for manpower utilization at these five

locations. Because the combined utilization for these five division offices only represented a small proportion (6 to 7 percent) of the USACE total, and because reported utilization at the other division offices closely matched CERAMMS allocations, this step did not compromise our results.

CALCULATIONS

CERAMMS generates estimates for USACE, divisions, or districts using program dollar amounts (which are then translated into placement) as inputs. Since we wanted to generate manpower estimates for all organizations simultaneously using placement as inputs, we created a model incorporating all relevant CERAMMS statistical algorithms. This model does not estimate funding requirements, because they were not being validated. Additional parameters such as in-house design proportions, number of area offices, and average project sizes were updated using actual data.

Nine different types of manpower requirements are estimated by CERAMMS as a function of design and/or construction placement. For the validation, we defined "earned" manpower as the requirement generated by CERAMMS based on actual placement. The district office support staffing equation, which had been based solely on design placement, was re-estimated using original CERAMMS data to reflect both design and construction placement. Table 2-1 displays the manpower types, the fund type and organizational levels at which they were calculated, and the three manpower categories into which they were grouped.

Since CERAMMS is the basis for manpower allocations at the division level, but not at the district level, only the division and USACE manpower estimates were validated. Similarly, Defense Environmental Restoration Program (DERP) manpower has historically been allocated outside of CERAMMS, so these figures were not validated (although DERP allocations were included in division totals to maintain comparability).

The validation calculations were performed for 20 districts and 8 divisions, representing over 80 percent of all USACE military construction and design placement. The Huntsville, Lower Mississippi Valley, and North Central Divisions were excluded because they do not receive military manpower allocations through CERAMMS. The European Division was excluded because it is treated separately by CERAMMS. The Philadelphia, Charleston, Jacksonville, and Wilmington Districts

TABLE 2-1
SUMMARY OF VALIDATION CALCULATIONS

Type of manpower	Fund type level		Organizational level		Manpower category
	Indiv.	Total	District	Division	
In-house design	X		X		Engineering
A-E design	X		X		Engineering
Engineering during construction	X		X		Engineering
Field construction	X		X		Construction
District office construction		X	X		Construction
District office engineering		X	X		Engineering
District office support		X	X		Other
Division office		X		X	Other

Note: A-E = architect-engineer firm.

were excluded because they have little or no military placement. The New England Division was included, but was treated as a district within the North Atlantic Division to avoid the estimation of redundant division and district office manpower requirements.

RESULTS

Tables 2-2, 2-3, 2-4, and 2-5 show the number of man-years earned, the number of man-years utilized, and the proportion of utilized man-years that were "unearned" [defined as (utilized - earned)/utilized] at the division level for total, engineering, construction, and other (support) manpower, respectively. All four tables present FY88 and FY89 data for each division separately and for all divisions combined.

The division codes used in these tables (and elsewhere in this report) are defined in Table 1-1. Table 2-6 displays the amounts of construction and design (engineering) placement for each division and fiscal year. Variations in the size and composition of workload account for much of the differences in the division-level results for all four manpower categories (total, engineering, construction, and other).

As shown in Table 2-2, the number of USACE total man-years unearned fell from 9 percent of man-years utilized in FY88 to 1 percent of man-years utilized in FY89. This decrease was caused by reduced manpower utilization; total man-years earned were almost identical for the 2 years. Most divisions also had less unearned manpower in FY89 than in FY88, although NPD and SWD earned considerably fewer man-years than they utilized in both years, while NAD and ORD earned more man-years than they utilized in both years.

As shown in Table 2-3, the number of USACE engineering man-years unearned fell from 17 percent of man-years utilized in FY88 to 1 percent of man-years utilized in FY89. This considerable decrease in excess engineering manpower had two causes: an 8 percent drop in man-years utilized, reflecting normal attrition; and a 9 percent increase in man-years earned, reflecting higher design placement.

As shown in Table 2-4, USACE construction man-years unearned fell from -4 percent of man-years utilized in FY88 to -16 percent of man-years utilized in FY89. Although construction man-years earned fell by 4 percent (reflecting lower construction placement), the increased shortfall in construction manpower was largely the result of a 14 percent drop in man-years utilized. In particular, normal attrition was exacerbated by supervision and administration (S&A) funding problems.

As shown in Table 2-5, the number of USACE other man-years unearned equaled 17 percent of man-years utilized in FY88 and 16 percent of man-years utilized in FY89. Other man-years unearned were virtually the same – in both absolute and relative terms – for both years, since there was very little change in either other man-years earned or other man-years utilized.

TABLE 2-2
VALIDATION RESULTS FOR TOTAL MAN-YEARS

Division	Fiscal year	Total man-years earned	Total man-years utilized	Total man-years unearned (%)
MRD	1988	1,184	1,259	6
MRD	1989	1,346	1,250	- 8
NAD	1988	1,564	1,444	- 8
NAD	1989	1,427	1,407	- 1
NPD	1988	742	886	16
NPD	1989	665	742	10
ORD	1988	539	463	- 16
ORD	1989	539	465	- 16
POD	1988	1,334	1,636	18
POD	1989	1,359	1,360	0
SAD	1988	1,223	1,587	23
SAD	1989	1,470	1,502	2
SPD	1988	1,057	1,045	- 1
SPD	1989	896	979	8
SWD	1988	975	1,182	18
SWD	1989	952	1,036	8
USACE	1988	8,618	9,502	9
USACE	1989	8,654	8,741	1

Notes: NAD includes NED; USACE totals exclude EUD, HND, LMVD, and NCD (Division Codes are explained in Table 1-1.)

TABLE 2-3
VALIDATION RESULTS FOR ENGINEERING MAN-YEARS

Division	Fiscal year	Engineering man-years earned	Engineering man-years utilized	Engineering man-years unearned (%)
MRD	1988	349	486	28
MRD	1989	540	500	- 8
NAD	1988	370	345	- 7
NAD	1989	314	325	3
NPD	1988	219	288	24
NPD	1989	177	243	27
ORD	1988	142	180	21
ORD	1989	148	165	10
POD	1988	337	407	17
POD	1989	344	353	3
SAD	1988	430	552	22
SAD	1989	588	496	- 19
SPD	1988	326	282	- 16
SPD	1989	297	297	0
SWD	1988	302	431	30
SWD	1989	293	362	19
USACE	1988	2,475	2,971	17
USACE	1989	2,701	2,741	1

Notes: NAD includes NED; USACE totals exclude EUD, HND, LMVD, and NCD.

TABLE 2-4
VALIDATION RESULTS FOR CONSTRUCTION MAN-YEARS

Division	Fiscal year	Construction man-years earned	Construction man-years utilized	Construction man-years unearned (%)
MRD	1988	440	379	- 16
MRD	1989	402	330	- 22
NAD	1988	770	551	- 40
NAD	1989	744	512	- 45
NPD	1988	284	298	5
NPD	1989	294	246	- 20
ORD	1988	237	157	- 51
ORD	1989	231	164	- 41
POD	1988	503	666	24
POD	1989	502	513	2
SAD	1988	418	471	11
SAD	1989	430	413	- 4
SPD	1988	412	406	- 1
SPD	1989	324	366	11
SWD	1988	398	385	- 3
SWD	1989	380	295	- 29
USACE	1988	3,462	3,313	- 4
USACE	1989	3,307	2,839	- 16

Notes: NAD includes NED; USACE totals exclude EUD, HND, LMVD, and NCD

TABLE 2-5
VALIDATION RESULTS FOR OTHER MAN-YEARS

Division	Fiscal year	Other man-years earned	Other man-years utilized	Other man-years unearned (%)
MRD	1988	395	394	- 0
MRD	1989	404	420	4
NAD	1988	424	548	23
NAD	1989	369	570	35
NPD	1988	239	300	20
NPD	1989	194	253	23
ORD	1988	160	126	- 27
ORD	1989	160	136	- 18
POD	1988	494	563	12
POD	1989	513	494	- 4
SAD	1988	375	564	34
SAD	1989	452	593	24
SPD	1988	319	357	11
SPD	1989	275	316	13
SWD	1988	275	366	25
SWD	1989	279	379	26
USACE	1988	2,681	3,218	17
USACE	1989	2,646	3,161	16

Notes: NAD includes NED; USACE totals exclude EUD, HND, LMVD, and NCD.

TABLE 2-6
CONSTRUCTION AND DESIGN PLACEMENT DATA

Division	Fiscal year	Construction placement (\$ millions)	Design placement (\$ millions)
MRD	1988	300	722
MRD	1989	319	751
NAD	1988	633	601
NAD	1989	628	477
NPD	1988	320	314
NPD	1989	287	230
ORD	1988	178	200
ORD	1989	170	213
POD	1988	352	942
POD	1989	357	1,010
SAD	1988	331	650
SAD	1989	334	867
SPD	1988	340	509
SPD	1989	238	465
SWD	1988	346	389
SWD	1989	310	432
USACE	1988	2,800	4,326
USACE	1989	2,642	4,446

Notes: NAD includes NED; USACE totals exclude EUD, HND, LMVD, and NCD; Division totals may not exactly add to USACE totals because of rounding

CHAPTER 3

CERAMMS ENHANCEMENT

METHODOLOGY

The first step in developing a TDA-compatible functional breakdown of CERAMMS manpower estimates was to identify those SWCCs that apply to functions covered by CERAMMS. Of the more than 2,000 SWCCs defined for Army manpower, USACE has used over 300 in recent TDA submissions. LMI examined these 300+ codes carefully. We first eliminated invalid or clearly inappropriate codes and then had to choose among multiple SWCCs that seemed to address the same function. In most such cases we chose the SWCC for which the largest amount of manpower had been reported by USACE. This process generated an initial list of about 30 SWCCs.

We next had to estimate the relative importance (in terms of manpower utilization) for each SWCC-defined function. We could not use actual data for this purpose, since the organizational coding used by USACE is not detailed enough, so we turned to USACE personnel with expertise in these functions. We convened three panels of USACE headquarters, division office, and district office staff – one for engineering, one for construction, and one for support services. Each panel was asked to revise our initial list of SWCCs and then estimate the relative amounts of manpower required to perform each SWCC-defined function.

Using Expert Choice,¹ we calculated manpower utilization coefficients for each SWCC on the revised list based on the inputs from these panels. This process is described in Appendix B. Coefficients for engineering and construction SWCCs were calculated separately for military construction, operations and maintenance, and family housing. Only one set of coefficients was calculated for support services

¹Expert Choice is a computer software package that allows individuals or groups to estimate relative weights (based on importance or other criteria) for multiple factors (e.g., different types of manpower) by making structured comparisons between each pair of factors and then mathematically combining all such pairwise comparisons into a single set of normalized weights. Expert Choice was copyrighted by Decision Support Software, Inc., McLean, VA, 1983.

SWCCs, since USACE personnel felt that relative manpower utilization for these functions was the same for all major types of work.

RESULTS

Our final list contained 38 SWCCs, of which 8 were for engineering, 4 for construction, and 26 for support services. These codes and the coefficients that we estimated are shown in Table 3-1. For example, the results imply that Engineering Operations Staff (ECA) represents 41.2 percent of all engineering manpower required for military construction, 29.4 percent of all engineering manpower required for family housing, and 43.1 percent of all engineering manpower required for operations and maintenance.

No data for actual manpower utilization were available to check the accuracy of the engineering and construction SWCC coefficients. We therefore collected utilization data for major support functions (resource management, information management, etc.) as part of the validation data call described in Chapter 2. These utilization data were converted into percentages and then compared to the sum of the coefficients for all SWCCs within each function.

The results of these comparisons are shown in Table 3-2 for FY88 and Table 3-3 for FY89. For the 20 districts and operating divisions that responded to the data call and were included in the CERAMMS validation, the combined average breakdown of support services manpower was very similar to the distribution predicted by the SWCC coefficients for most functions. For example, the sum of the estimated coefficients for the four resource management SWCCs (FBA, FFA, FGB, and FGE) is 28 percent, while the average resource management share of support services manpower utilization was 28 percent for both FY88 and FY89.

The actual distributions vary widely among individual districts. This variation exists because functions such as personnel and information management are performed at the division level in some divisions and at the district level in others, and because functions such as contracting may be performed by engineering or construction staff at some locations and by support services staff at others. The uses and limitations of these SWCC coefficients, and of the related CERAMMS enhancement described below, are discussed in Chapter 4.

TABLE 3-1
COEFFICIENTS FOR DISAGGREGATION OF CERAMMS ESTIMATES BY SWCC

CERAMMS category and Army Functional Dictionary title	SWCC ^a	Military construction	Family housing	Operations and maintenance
Engineering				
Engineering operations staff	ECA	0.412	0.294	0.431
General engineering	ECB	0.040	0.034	0.078
Electrical and mechanical engineering	ECC	0.103	0.102	0.138
Geo-technical engineering	ECD	0.148	0.162	0.037
Civil/environmental engineering	ECF	0.049	0.080	0.035
Structural engineering operations	EDB	0.195	0.272	0.230
Master planning	EEA	0.017	0.018	0.021
Engineering management activities	EFA	0.036	0.038	0.030
		1.000	1.000	1.000
Construction				
Construction staff	EKA	0.032	0.033	0.021
Construction supervision and inspection	ELA	0.630	0.647	0.605
Construction contract administration	ELB	0.149	0.087	0.230
Construction program management staff	ELD	0.189	0.233	0.144
		1.000	1.000	1.000
Support Services				
Legal services management staff	BPA	0.010	0.010	0.010
Civil law management staff	BSD	0.014	0.014	0.014
Legal services operations	BYA	0.008	0.008	0.008
Information management staff	DAA	0.021	0.021	0.021
Information systems management and support	DAB	0.021	0.021	0.021
Information systems operations staff	DBA	0.040	0.040	0.040
ADP systems analysis, design, & programming	DND	0.010	0.010	0.010
ADP mgt. and technical support mgt. staff	DNG	0.050	0.050	0.050
Finance and accounting staff	FBA	0.173	0.173	0.173
Budget staff	FFA	0.051	0.051	0.051
Management analysis	FGB	0.034	0.034	0.034
Resource management activities	FGE	0.022	0.022	0.022
Acquisition management staff	GAA	0.022	0.022	0.022
Contracting	GBC	0.125	0.125	0.125
Contract administration	GBD	0.114	0.114	0.114
Purchasing	GBE	0.030	0.030	0.030
Acquisition management operations staff	GBF	0.016	0.016	0.016
Facilities engineering resources mgt. staff	JCE	0.014	0.014	0.014
Transportation control	LCD	0.036	0.036	0.036
Maintenance engineering management staff	LGC	0.014	0.014	0.014
Supply and services management	MCB	0.080	0.080	0.080
Technical services	RBA	0.030	0.030	0.030
Position and pay management	RBB	0.013	0.013	0.013
Recruitment and placement	RBC	0.030	0.030	0.030
Labor/management-employee relations	RCB	0.004	0.004	0.004
Operations staff	XBA	0.018	0.018	0.018
		1.000	1.000	1.000

^a SWCCs are defined in Appendix C.

TABLE 3-2

COMPARISON OF ACTUAL SUPPORT SERVICES MANPOWER DISTRIBUTION
(MILITARY MAN-YEARS UTILIZED) WITH ESTIMATED SWCC COEFFICIENTS: FY88

District/ operating division	Resource mgmt. (%)	Personnel (%)	Information mgmt. (%)	Logistics (%)	Contracting (%)	Counsel (%)	Office/ admin. (%)	Other (%)
MRK	8	8	38	10	17	8	11	0
MRO	42	9	23	4	12	5	5	0
NAB	21	11	15	8	30	8	7	0
NAN	25	10	15	7	20	11	11	0
NAO	25	6	24	15	17	4	10	0
NED	80	0	7	2	5	1	5	0
NPA	27	8	26	6	18	4	4	6
NPS	11	13	32	13	18	4	10	0
CRL	19	0	38	10	19	7	7	0
POD	40	2	24	9	14	5	6	0
POF	14	0	21	38	18	3	6	0
POJ	26	0	17	12	27	3	17	0
SAI	22	8	20	7	14	5	6	16
SAM	25	12	28	9	12	5	8	0
SAS	27	0	24	9	16	6	17	0
SPK	35	0	29	7	17	2	9	0
SPL	32	0	31	7	10	7	12	0
SWF	25	13	15	5	20	8	13	0
SWL ^a	0	0	0	0	0	0	0	0
SWT	49	5	21	2	12	5	7	0
Total^b	28	6	23	10	17	6	9	1
SWCC	28	8	14	14	31	3	N/A	2

^a No support services military manpower utilization reported for FY88 by SWL.^b Distribution of combined manpower for all reporting districts and operating divisions.

TABLE 3-3

**COMPARISON OF ACTUAL SUPPORT SERVICES MANPOWER DISTRIBUTION
(MILITARY MAN-YEARS UTILIZED) WITH ESTIMATED SWCC COEFFICIENTS: FY89**

District/ operating division	Resource mgmt. (%)	Personnel (%)	Information mgmt. (%)	Logistics (%)	Contracting (%)	Counsel (%)	Office/ admin. (%)	Other (%)
MRK	9	11	27	9	21	9	16	0
MRO	42	9	22	3	14	4	5	0
NAB	22	11	16	9	30	7	5	0
NAN	26	12	16	9	20	9	8	0
NAO	23	7	22	13	18	6	11	0
NED	79	0	8	2	6	1	4	0
NPA	25	9	26	6	20	5	3	5
NPS	10	12	33	12	19	4	10	0
ORL	17	0	39	9	17	12	6	0
POD	38	2	25	10	13	5	7	0
POF	17	0	20	35	17	4	7	0
POJ	25	0	21	12	23	2	16	0
SAI	20	8	20	7	17	4	6	19
SAM	25	11	26	9	13	5	10	0
SAS	26	0	21	9	19	7	18	0
SPK	34	0	29	8	17	3	10	0
SPL	31	0	30	9	10	6	14	0
SWF	25	13	15	5	22	9	11	0
SWL	20	20	32	9	9	9	0	0
SWT	47	5	16	7	10	5	9	1
Total^a	28	7	23	9	18	6	9	2
SWCC	28	8	14	14	31	3	N/A	2

^a Distribution of combined manpower for all reporting districts and operation divisions.

CHANGES TO MODEL

We have automated the functional breakdown process by adding a new module to the latest version (4.0) of CERAMMS. The engineering, construction, and support services requirements (by type of work) estimated by CERAMMS are read into the new module, where they are multiplied by the appropriate coefficients to generate SWCC-level estimates that can be used to develop the TDA. This module can be modified to accommodate any future changes to the list of SWCCs and/or to the corresponding coefficients.

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

CERAMMS Validity

Our results show that CERAMMS estimates of manpower requirements at the USACE and division levels are valid. Utilized and unearned man-years both fell sharply between FY88 and FY89, as staffing levels were adjusted to reflect falling workloads. Manpower cuts (beyond normal attrition) generally lag behind workload cuts; reductions in force are very time-consuming. In addition, many managers are reluctant to cut their staffs because of concern for the people affected and because they hope that the workload cuts may only be temporary.

The greater proportions of unearned man-years for individual categories at the USACE level, and for all categories at the division level, do not invalidate CERAMMS. Variations in how divisions are organized, variations in the degree to which functions are centralized, previous resource allocation decisions, and changes in workload all cause actual manpower to differ from earned manpower. District manpower allocations are not necessarily based on CERAMMS, which is why a district-level validation was not appropriate.

Functional Breakdown

Within the limitations imposed by the TDA and USAFISA, we believe that the 38 SWCCs represent a meaningful classification of USACE manpower for military programs. Although some of the codes do not exactly match USACE job descriptions (particularly for engineering and construction), this set represents a vast improvement over previous classification efforts.

With the same caveat, we believe that the coefficients for these SWCCs provide an accurate and useful functional breakdown of USACE military manpower. While deviations occur because of organizational or accounting differences among districts,

the estimated coefficients closely match the actual distribution of manpower by function at an "average" district.

RECOMMENDATIONS

Seek USAFISA Recognition

Based on our conclusion that CERAMMS is valid, and given that CERAMMS has been modified to incorporate a SWCC-based functional breakdown, we recommend that USACE seek USAFISA recognition of CERAMMS as the official basis for determining USACE military program manpower requirements. This action will greatly increase the number of personnel covered by USAFISA standards and improve the quality of USACE inputs into the TDA.

Defer Updating of CERAMMS Equations

Although the statistical relationships in CERAMMS are currently valid, some of them might change over time. However, until USACE's workload, staffing, and organizational structure stabilize, re-estimating these relationships could generate misleading results. We therefore recommend that any updating of current CERAMMS equations be deferred for several years.

USACE Staffing

Our validation results also have potentially significant implications for USACE staffing policies. Based on the proportions of unearned man-years in FY88 and FY89, we recommend that USACE management adopt different strategies for the engineering, construction, and support services categories.

First, USACE should not increase its engineering staff. Although virtually all engineering man-years were earned in FY89, earned engineering man-years are likely to fall faster than normal attrition in FY90 because of the expected reduction in design workload (especially given the current moratorium). Such a workload decrease would create a manpower excess like that in FY88; additional hiring would add to the problem.

Second, USACE should increase its construction staff within the constraints imposed by S&A funding limits. Given that earned construction man-years exceeded actual construction man-years by 16 percent in FY89, and given the probability of

additional reductions in construction staff through normal attrition, it is unlikely that the shortfall will be eliminated solely through program cuts.

Third, USACE should reduce its support staff. Given the persistence of excess support manpower (16 to 17 percent unearned man-years in both FY88 and FY89), the low apparent level of attrition within this category, and the unlikelihood of significant increases in design or construction workload, more aggressive action may be needed to solve this problem.

Use of SWCCs

We recommend that USACE adopt the SWCCs and coefficients listed in Table 3-1. This action will improve the quality (while simplifying the preparation) of TDA manpower inputs. An improved ability to classify current manpower by SWCC, and the newly developed ability to forecast future manpower requirements by SWCC, will help USACE justify its staffing levels to Army, DoD, and Congress. USACE can also use these codes and coefficients to make more efficient use of its increasingly limited military manpower resources. The support services SWCCs will prove most valuable for this purpose because they most closely match actual USACE functionality.

USACE has never taken SWCCs seriously or used them internally, largely because many USACE functions are poorly defined by current SWCCs. USACE recently reported over 16,500 personnel in 331 different SWCCs. Almost 1,500 of these people were classified in 59 invalid SWCCs, and a number of others were classified in valid but inappropriate SWCCs (such as the 22 people whose reported function was heraldry). SWCCs will probably become more important as defense budgets (and staffing levels) decline, so improvements in USACE's use of these codes are clearly needed.

Future refinements to Table 3-1 can be made. USACE has the authority to modify existing SWCC definitions or to add new SWCCs. The ongoing use of SWCCs will generate data from which more accurate coefficients can be estimated. For the present, however, it is more important for USACE headquarters and field staff to agree upon a common set of SWCCs for reporting and classifying manpower. We believe that adopting our list would be a major step in this direction.

Efficiency Reviews

USACE Resource Management would like to identify districts where efficiency reviews might be productive. The validation results should be used with caution for such purposes, since inefficiency is not the only factor leading to large amounts of unearned manpower. Unearned manpower can also occur from incorrect expectations about future workloads, declining design and construction programs, inappropriate distributions of division manpower allocations, unusually small or specialized workloads, previous resource allocation decisions, or shifting of resources among districts within a division.

To select sites for future efficiency reviews, USACE should focus on districts that meet these three criteria:

- High unearned manpower, in terms of both percentage and man-years
- Large, diversified, and stable workloads
- All other districts in division also have high unearned manpower.

"Efficient" districts should be reviewed to identify policies and procedures that can be beneficially applied to other parts of USACE, while "inefficient" districts should be reviewed to identify problems that can be corrected.

As part of its efficiency reviews, USACE Resource Management would like to identify any functions within a district that are inappropriately staffed. Ideally, this could be done by comparing the district's actual manpower mix to the estimated SWCC coefficients. However, it is not possible to calculate the actual breakdown of engineering or construction manpower by SWCC, so only the support services coefficients can be used for this purpose. In addition, the SWCC coefficients represent an average, and deviations from this average can be expected for a number of valid reasons. Finally, districts experiencing rapid changes in workload or staffing will find it hard to maintain the proper manpower mix, especially in the short run.

APPENDIX A

CERAMMS VALIDATION DATA

This appendix contains detailed data used in validating CERAMMS. Table A-1 defines the division and district codes used in many of the tables in this report. Table A-2 defines the Corps of Engineers Resource and Military Manpower System (CERAMMS) fund type categories used to classify military workload. Table A-3 displays actual military construction placement and military design placement in current (then-year) dollars, by district and fund type, for fiscal years 1988 and 1989. Division and United States Army Corps of Engineers (USACE) totals are also included. The source for these figures is the Corps of Engineers Management Information System (COEMIS) 3018C Reports.

Table A-4 displays the proportions of engineering/design work done in-house by each district in FY88 and FY89. These proportions have a major impact on engineering manpower requirements. The proportions for engineering not related to construction (ENRC) are assumptions made by USACE headquarters personnel in developing CERAMMS allocations, and are the same for all districts within a division. The proportions for all other types of design are based on actual data (from COEMIS 3018C Reports) and in some cases differ substantially from the CERAMMS assumptions.

TABLE A-1
USACE DIVISION AND DISTRICT CODE DEFINITIONS

Code	Division or district
EUD	European Division
HND	Huntsville Division
LMVD	Lower Mississippi Valley Division
LMM	Lower Mississippi, Memphis District
LMN	Lower Mississippi, New Orleans District
LMS	Lower Mississippi, St. Louis District
LMK	Lower Mississippi, Vicksburg District
MRD	Missouri River Division
MRK	Missouri River, Kansas City District
MRO	Missouri River, Omaha District
NAD	North Atlantic Division
NAB	North Atlantic, Baltimore District
NAN	North Atlantic, New York District
NAO	North Atlantic, Norfolk District
NAP	North Atlantic, Philadelphia District
NCD	North Central Division
NCB	North Central, Buffalo District
NCC	North Central, Chicago District
NCE	North Central, Detroit District
NCR	North Central, Rock Island District
NCS	North Central, St. Paul District
NED	New England Division
NPD	North Pacific Division
NPA	North Pacific, Anchorage District
NPP	North Pacific, Portland District
NPS	North Pacific, Seattle District
NPW	North Pacific, Walla Walla District

TABLE A-1
USACE DIVISION AND DISTRICT CODE DEFINITIONS (Continued)

Code	Division or district
ORD	Ohio River Division
ORH	Ohio River, Huntington District
ORL	Ohio River, Louisville District
ORN	Ohio River, Nashville District
ORP	Ohio River, Pittsburgh District
POD	Pacific Ocean Division
POH	Pacific Ocean, Honolulu District
POF	Pacific Ocean, Far East District
POJ	Pacific Ocean, Japan District
SAD	South Atlantic Division
SAC	South Atlantic, Charleston District
SAI	South Atlantic, Middle East/Africa Projects Office
SAJ	South Atlantic, Jacksonville District
SAM	South Atlantic, Mobile District
SAS	South Atlantic, Savannah District
SAW	South Atlantic, Wilmington District
SPD	South Pacific Division
SPK	South Pacific, Sacramento District
SPL	South Pacific, Los Angeles District
SPN	South Pacific, San Francisco District
SWD	South West Division
SWA	South West, Albuquerque District
SWF	South West, Fort Worth District
SWG	South West, Galveston District
SWL	South West, Little Rock District
SWT	South West, Tulsa District

TABLE A-2
CERAMMS FUND TYPE CATEGORY DEFINITIONS

Fund type	Definition
MCA	Military Construction: Army
MCAR	Military Construction: Army Reserve
MCAF	Military Construction: Air Force
MCO	Military Construction: Other
OMA	Operations and Maintenance: Army
OMAF	Operations and Maintenance: Air Force
FHA	Family Housing: Army
FHAF	Family Housing: Air Force
PBS	Production Base Support
HN	Host Nation
FMS	Foreign Military Sales
DERP	Defense Environmental Restoration Program
ENRC	Engineering Not Related To Construction

TABLE A-3
CERAMMS VALIDATION: FY88 AND FY89 PLACEMENT DATA

Office code	Fund type	FY88 construction (\$)	FY88 design (\$)	FY89 construction (\$)	FY89 design (\$)
MRK	MCA	43,730,000	40,424,000	36,074,000	43,000,000
MRK	MCAR	2,485,000	33,464,000	426,000	15,300,000
MRK	MCAF	35,187,000	56,901,000	56,575,000	165,121,000
MRK	MCO	1,883,000	7,919,000	14,161,000	3,780,000
MRK	OMA	13,051,000	496,000	8,510,000	375,000
MRK	OMAF	7,371,000	1,930,000	65,000	120,000
MRK	FHA	2,322,000	5,282,000	4,584,000	2,700,000
MRK	PBS	6,060,000	21,244,000	3,603,000	30,500,000
MRK	ENRC	0	200,000	0	811,000
MRK		112,089,000	167,860,000	123,998,000	261,707,000
MRO	MCA	13,546,000	10,951,000	6,918,000	22,106,000
MRO	MCAR	2,478,000	50,000	9,365,000	50,000
MRO	MCAF	138,661,000	294,569,000	110,596,000	231,035,000
MRO	MCO	803,000	2,900,000	31,390,000	291,000
MRO	OMA	2,633,000	10,360,000	4,289,000	4,969,000
MRO	OMAF	5,479,000	740,000	2,942,000	2,450,000
MRO	FHA	1,487,000	953,000	3,394,000	0
MRO	FHAF	637,000	0	587,000	150,000
MRO	PBS	4,044,000	4,099,000	1,279,000	6,390,000
MRO	DERP	17,798,000	229,178,000	24,028,000	221,915,000
MRO	ENRC	0	53,000	0	0
MRO		187,566,000	553,853,000	194,788,000	489,356,000
MRD		299,655,000	721,713,000	318,786,000	751,063,000
NAB	MCA	109,511,000	63,629,000	56,348,000	100,296,000
NAB	MCAR	3,713,000	13,281,000	3,470,000	10,222,000
NAB	MCAF	9,616,000	12,801,000	5,118,000	13,289,000
NAB	MCO	83,470,000	74,583,000	56,215,000	96,689,000
NAB	OMA	27,247,000	23,236,000	28,433,000	1,550,000
NAB	OMAF	70,000	7,439,000	0	1,992,000
NAB	FHA	23,747,000	3,486,000	13,986,000	3,718,000

TABLE A-3
CERAMMS VALIDATION: FY88 AND FY89 PLACEMENT DATA (Continued)

Office code	Fund type	FY88 construction (\$)	FY88 design (\$)	FY89 construction (\$)	FY89 design (\$)
NAB	PBS	33,381,000	2,322,000	36,978,000	61,000
NAB	ENRC	0	134,000	0	28,000
NAB		290,755,000	200,911,000	200,548,000	227,845,000
NAN	MCA	78,028,000	92,638,000	187,081,000	52,244,000
NAN	MCAR	8,608,000	17,473,000	3,665,000	8,078,000
NAN	MCAF	37,213,000	37,393,000	23,845,000	38,855,000
NAN	MCO	9,649,000	7,913,000	9,999,000	8,053,000
NAN	OMA	16,613,000	6,665,000	19,856,000	15,991,000
NAN	OMAF	4,930,000	11,297,000	3,772,000	1,993,000
NAN	FHA	57,918,000	1,736,000	39,421,000	2,663,000
NAN	FHAF	49,000	0	2,000	0
NAN	PBS	10,762,000	5,440,000	7,104,000	10,011,000
NAN	DERP	103,000	0	0	434,000
NAN		223,873,000	180,555,000	294,745,000	138,322,000
NAO	MCA	21,401,000	14,457,000	30,645,000	10,222,000
NAO	MCAR	4,665,000	9,698,000	1,303,000	527,000
NAO	MCAF	18,531,000	6,688,000	11,808,000	113,000
NAO	MCO	1,209,000	33,348,000	11,667,000	5,368,000
NAO	OMA	9,033,000	36,755,000	17,655,000	14,747,000
NAO	OMAF	3,887,000	628,000	759,000	64,000
NAO	FHA	6,468,000	37,778,000	2,923,000	15,915,000
NAO	FHAF	0	0	0	96,000
NAO	PBS	14,450,000	5,168,000	20,514,000	4,343,000
NAO		79,644,000	144,520,000	97,274,000	51,395,000
NED	MCA	15,189,000	22,500,000	5,315,000	13,083,000
NED	MCAR	0	580,000	763,000	4,132,000
NED	MCAF	12,689,000	9,440,000	19,891,000	3,070,000
NED	MCO	402,000	1,710,000	37,000	2,989,000
NED	OMA	4,902,000	30,220,000	5,580,000	32,753,000
NED	OMAF	2,266,000	370,000	1,743,000	332,000

TABLE A-3
CERAMMS VALIDATION: FY88 AND FY89 PLACEMENT DATA (Continued)

Office code	Fund type	FY88 construction (\$)	FY88 design (\$)	FY89 construction (\$)	FY89 design (\$)
NED	FHA	3,169,000	9,850,000	2,421,000	3,241,000
NED		38,617,000	74,670,000	35,750,000	59,600,000
NAD^a		632,889,000	600,656,000	628,317,000	477,162,000
NPA	MCA	46,711,000	70,564,000	45,975,000	10,697,000
NPA	MCAR	0	0	0	891,000
NPA	MCAF	40,840,000	66,160,000	58,449,000	30,427,000
NPA	MCO	1,726,000	5,015,000	13,579,000	0
NPA	OMA	14,044,000	2,173,000	6,251,000	6,142,000
NPA	OMAF	16,635,000	11,692,000	9,847,000	7,560,000
NPA	FHA	0	2,227,000	22,732,000	17,344,000
NPA		119,956,000	157,831,000	156,833,000	73,061,000
NPS	MCA	15,330,000	51,907,000	15,137,000	51,907,000
NPS	MCAR	2,631,000	7,969,000	438,000	7,969,000
NPS	MCAF	55,672,000	47,632,000	39,462,000	47,632,000
NPS	MCO	104,081,000	28,596,000	59,616,000	28,596,000
NPS	OMA	12,637,000	10,453,000	9,147,000	10,453,000
NPS	OMAF	5,982,000	3,961,000	2,854,000	3,961,000
NPS	FHA	3,693,000	3,513,000	3,067,000	5,133,000
NPS	FHAF	181,000	1,769,000	0	1,685,000
NPS	PBS	54,000	0	169,000	0
NPS	DERP	0	14,000	0	14,000
NPS	ENRC	0	0	0	30,000
NPS		200,261,000	155,814,000	129,890,000	157,380,000
NPD		320,217,000	313,645,000	286,723,000	230,441,000
ORL	MCA	37,891,000	18,936,000	26,424,000	44,951,000
ORL	MCAR	6,181,000	11,520,000	6,163,000	9,217,000
ORL	MCAF	54,133,000	56,147,000	67,705,000	40,090,000
ORL	MCO	10,734,000	27,137,000	10,397,000	34,287,000
ORL	OMA	24,404,000	29,924,000	21,386,000	29,307,000
ORL	OMAF	937,000	3,401,000	4,487,000	10,907,000

^a Includes NED.

TABLE A-3
CERAMMS VALIDATION: FY88 AND FY89 PLACEMENT DATA (Continued)

Office code	Fund type	FY88 construction (\$)	FY88 design (\$)	FY89 construction (\$)	FY89 design (\$)
ORL	FHA	12,617,000	17,669,000	11,854,000	12,346,000
ORL	PBS	30,677,000	34,346,000	21,652,000	30,427,000
ORL	ENRC	0	1,150,000	0	1,139,000
ORL		177,574,000	200,230,000	170,068,000	212,671,000
ORD		177,574,000	200,230,000	170,068,000	212,671,000
POF	MCA	83,162,000	59,680,000	88,142,000	65,332,000
POF	MCAF	39,829,000	39,425,000	47,787,000	48,755,000
POF	MCO	8,350,000	55,827,000	5,328,000	35,098,000
POF	OMA	15,583,000	0	10,659,000	10,590,000
POF	OMAF	14,643,000	14,463,000	16,572,000	7,146,000
POF	FHA	1,327,000	498,000	2,463,000	3,864,000
POF	FHAF	0	307,000	0	421,000
POF	PBS	940,000	0	2,151,000	0
POF	HN	0	34,800,000	0	45,500,000
POF		163,834,000	205,000,000	173,102,000	216,706,000
POH	MCA	45,506,000	58,255,000	48,839,000	34,166,000
POH	MCAR	0	2,053,000	0	2,886,000
POH	MCAF	548,000	5,686,000	1,826,000	5,667,000
POH	MCO	4,102,000	6,131,000	12,347,000	34,782,000
POH	OMA	13,671,000	12,312,000	15,322,000	5,683,000
POH	OMAF	1,051,000	1,186,000	224,000	419,000
POH	FHA	32,556,000	37,225,000	31,266,000	25,621,000
POH	FHAF	0	0	661,000	0
POH	PBS	2,816,000	0	131,000	0
POH	ENRC	0	292,000	0	166,000
POH		100,250,000	123,140,000	110,616,000	109,390,000
POJ	MCA	1,220,000	7,657,000	2,511,000	2,061,000
POJ	MCAF	22,268,000	7,726,000	20,264,000	5,360,000
POJ	MCO	11,993,000	26,991,000	10,093,000	18,111,000
POJ	OMA	14,740,000	11,887,000	11,143,000	4,816,000

TABLE A-3

CERAMMS VALIDATION: FY88 AND FY89 PLACEMENT DATA (Continued)

Office code	Fund type	FY88 construction (\$)	FY88 design (\$)	FY89 construction (\$)	FY89 design (\$)
POJ	OMAF	19,120,000	20,410,000	15,716,000	4,554,000
POJ	FHA	3,512,000	1,276,000	2,203,000	404,000
POJ	FHAF	12,021,000	21,807,000	7,191,000	9,646,000
POJ	PBS	2,877,000	868,000	4,074,000	473,000
POJ	HN	0	515,439,000	0	638,474,000
POJ	ENRC	0	246,000	0	222,000
POJ		87,751,000	614,307,000	73,195,000	684,121,000
POD		351,835,000	942,447,000	356,913,000	1,010,217,000
SAI	MCA	0	7,143,000	0	10,831,000
SAI	MCAF	8,000	10,317,000	9,804,000	18,358,000
SAI	MCO	11,000	0	0	35,883,000
SAI	OMAF	171,000	0	652,000	0
SAI	FMS	0	47,108,000	2,268,000	146,379,000
SAI		190,000	64,568,000	12,724,000	211,451,000
SAM	MCA	56,099,000	32,106,000	34,445,000	34,358,000
SAM	MCAR	4,605,000	3,279,000	6,042,000	7,101,000
SAM	MCAF	51,745,000	246,853,000	88,336,000	278,868,000
SAM	MCO	17,320,000	32,459,000	11,010,000	41,463,000
SAM	OMA	11,924,000	18,923,000	14,575,000	20,180,000
SAM	OMAF	1,416,000	6,955,000	66,000	9,321,000
SAM	FHA	2,146,000	547,000	496,000	1,388,000
SAM	FHAF	0	646,000	0	0
SAM	PBS	14,827,000	31,553,000	13,919,000	28,679,000
SAM	FMS	0	1,774,000	0	12,740,000
SAM	ENRC	0	269,000	0	0
SAM		160,082,000	375,364,000	168,889,000	434,098,000
SAS	MCA	87,896,000	97,747,000	63,413,000	97,953,000
SAS	MCAR	1,392,000	13,474,000	3,712,000	11,435,000
SAS	MCAF	22,613,000	42,349,000	28,052,000	62,012,000
SAS	MCO	8,661,000	12,911,000	16,864,000	7,773,000

TABLE A-3

CERAMMS VALIDATION: FY88 AND FY89 PLACEMENT DATA (Continued)

Office code	Fund type	FY88 construction (\$)	FY88 design (\$)	FY89 construction (\$)	FY89 design (\$)
SAS	OMA	37,881,000	27,850,000	27,718,000	18,166,000
SAS	OMAF	900,000	3,079,000	13,000	85,000
SAS	FHA	7,361,000	11,427,000	10,909,000	3,417,000
SAS	FHAF	0	0	0	20,331,000
SAS	PBS	4,465,000	1,614,000	1,161,000	115,000
SAS		171,169,000	210,451,000	151,842,000	221,287,000
SAD		331,441,000	650,383,000	333,455,000	866,836,000
SPK	MCA	33,358,000	170,989,000	30,293,000	164,981,000
SPK	MCAR	1,830,000	13,566,000	3,811,000	13,767,000
SPK	MCAF	64,946,000	162,623,000	51,036,000	146,907,000
SPK	MCO	10,005,000	62,749,000	14,567,000	60,384,000
SPK	OMA	33,321,000	6,060,000	27,678,000	3,698,000
SPK	OMAF	1,295,000	323,000	1,265,000	9,000
SPK	FHA	26,541,000	18,414,000	40,727,000	39,811,000
SPK	PBS	29,792,000	73,806,000	9,486,000	35,748,000
SPK	ENRC	0	13,000	0	126,000
SPK		201,088,000	508,543,000	178,863,000	465,431,000
SPL	MCA	23,465,000	0	249,000	0
SPL	MCAR	894,000	0	5,738,000	0
SPL	MCAF	93,863,000	0	18,122,000	0
SPL	MCO	10,613,000	0	1,817,000	0
SPL	OMA	8,880,000	0	6,707,000	0
SPL	OMAF	874,000	0	819,000	0
SPL	FHA	699,000	0	25,862,000	0
SPL	FHAF	0	0	126,000	0
SPL		139,288,000	0	59,440,000	0
SPD		340,376,000	508,543,000	238,303,000	465,431,000
SWF	MCA	81,318,000	64,348,000	39,746,000	62,216,000
SWF	MCAR	1,589,000	4,212,000	3,047,000	6,312,000
SWF	MCAF	63,635,000	130,621,000	96,622,000	105,823,000

TABLE A-3
CERAMMS VALIDATION: FY88 AND FY89 PLACEMENT DATA (Continued)

Office code	Fund type	FY88 construction (\$)	FY88 design (\$)	FY89 construction (\$)	FY89 design (\$)
SWF	MCO	25,968,000	19,942,000	17,098,000	76,324,000
SWF	OMA	13,962,000	16,790,000	28,890,000	0
SWF	OMAF	6,988,000	1,615,000	12,039,000	0
SWF	FHA	26,921,000	27,617,000	24,470,000	284,000
SWF	FHAF	0	1,359,000	0	0
SWF	PBS	3,082,000	18,541,000	8,970,000	37,236,000
SWF	ENRC	0	907,000	0	299,000
SWF		223,463,000	285,952,000	230,882,000	288,494,000
SWL	MCA	17,713,000	4,649,000	14,820,000	2,672,000
SWL	MCAR	4,993,000	2,894,000	1,971,000	1,807,000
SWL	MCAF	6,621,000	6,918,000	5,772,000	7,497,000
SWL	OMA	739,000	0	1,372,000	0
SWL	OMAF	1,619,000	0	2,000	0
SWL	ENRC	0	168,000	0	61,000
SWL		31,685,000	14,629,000	23,937,000	12,037,000
SWT	MCA	23,369,000	3,380,000	7,305,000	14,940,000
SWT	MCAR	377,000	1,646,000	2,293,000	702,000
SWT	MCAF	59,836,000	49,460,000	39,615,000	40,266,000
SWT	MCO	0	25,795,000	2,851,000	47,849,000
SWT	OMA	1,485,000	4,249,000	1,768,000	26,232,000
SWT	OMAF	99,000	2,197,000	0	500,000
SWT	FHA	1,256,000	900,000	385,000	224,000
SWT	FHAF	0	0	0	527,000
SWT	PBS	4,544,000	195,000	800,000	138,000
SWT	ENRC	0	365,000	0	413,000
SWT		90,966,000	88,187,000	55,017,000	131,791,000
SWD		346,114,000	388,768,000	309,836,000	432,322,000
USACE		2,800,101,000	4,326,385,000	2,642,401,000	4,446,143,000

TABLE A-4
CERAMMS VALIDATION: FY88 AND FY89 DESIGN MIX

District code	Design percent in-house: FY88 (%)	Design percent in-house: FY89 (%)	ENRC percent in-house: FY88 (%)	ENRC percent in-house: FY89 (%)
MRK	20.6	51.5	14.0	29.5
MRO	16.1	21.9	14.0	29.5
NAB	6.2	2.9	15.0	19.2
NAN	17.3	25.8	15.0	19.2
NAO	19.7	12.7	15.0	19.2
NED	36.4	53.9	15.0	19.2
NPA	37.3	60.7	16.0	58.2
NPS	11.2	11.1	16.0	58.2
ORL	26.5	24.8	45.0	17.9
POF	8.2	8.2	30.0	18.3
POH	28.7	44.4	30.0	18.3
POJ	1.3	0.5	30.0	18.3
SAI	60.0	24.8	32.0	25.2
SAM	16.3	23.6	32.0	25.2
SAS	37.7	42.8	32.0	25.2
SPK	16.1	21.0	26.0	19.5
SPL ^a	N/A	N/A	N/A	N/A
SWF	36.3	30.3	35.0	24.8
SWL	27.9	22.8	35.0	24.8
SWT	34.3	39.6	35.0	24.8

^a SPL design was performed by SPK.

APPENDIX B

DETERMINATION OF SWCC COEFFICIENTS

INTRODUCTION

The Army Functional Dictionary (AFD), maintained by the U.S. Army Force Integration Support Agency (USAFISA), defines Standard Work Center Codes (SWCCs) that classify manpower for the Army's Tables of Distribution and Allowances (TDA). To obtain USAFISA acceptance of Corps of Engineers Resource and Military Manpower System (CERAMMS) manpower estimates, to ensure that United States Army Corps of Engineers (USACE) manpower needs are properly represented in the TDA, and to provide USACE management with more detailed information on functional manpower requirements, Logistics Management Institute (LMI) was asked to modify CERAMMS so that projections could be made for individual SWCCs.

DETERMINING THE RELEVANT SWC CODES

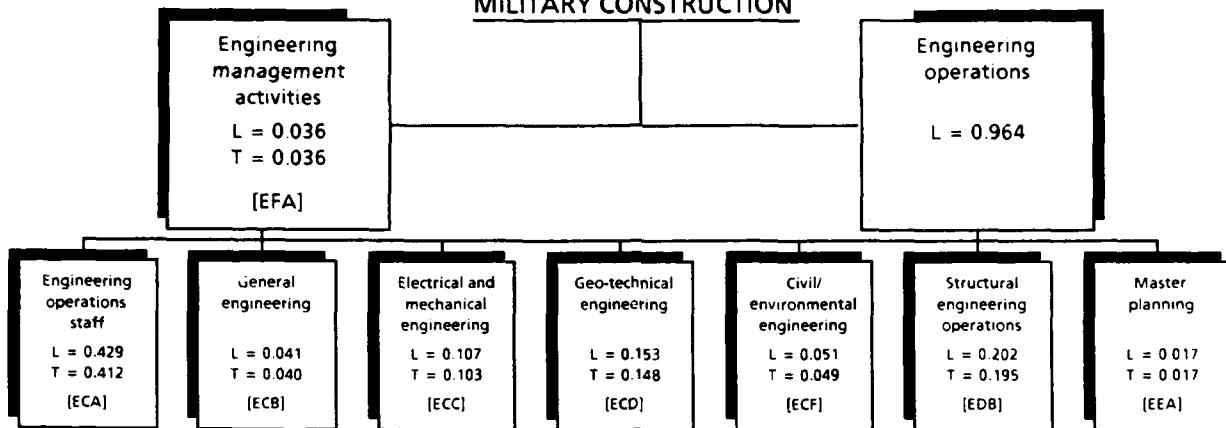
The first step in this process was to determine which SWCCs are relevant to USACE. Although USACE already used SWCCs to classify its manpower for the TDA, the Spring 1988 Management of Change (MOC) submission included over 300 such codes, many of which were either inappropriate or invalid. Starting from the MOC data, we used current AFD definitions and our knowledge of USACE operations to develop a revised list of about 30 SWCCs.

These codes were organized into hierarchical tree structures for the CERAMMS engineering, construction, and support services manpower categories to show work center relationships. These tree structures (which reflect some minor revisions that are discussed below) are shown in Figures B-1, B-2, and B-3. The AFD definitions associated with these SWCCs are presented in Appendix C.

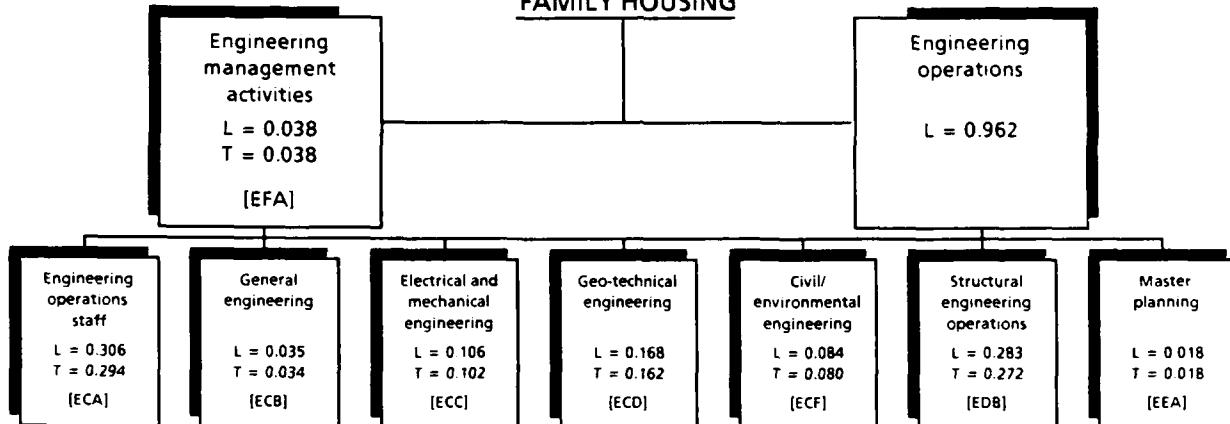
DEVELOPING RELATIVE WEIGHTS FOR EACH SWCC

The next step was to develop relative weights for each SWCC, i.e., the relative amounts of manpower associated with each functional category. It was not feasible

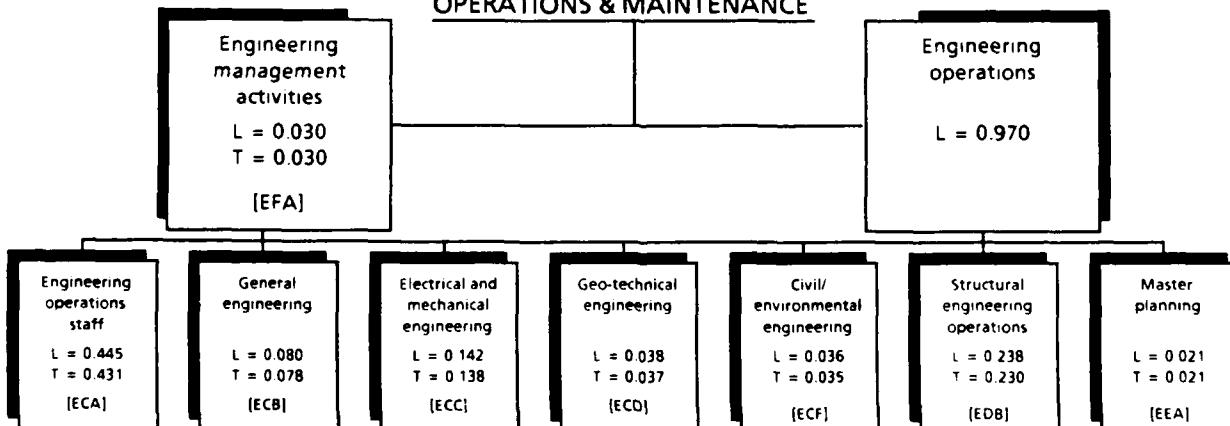
**ENGINEERING:
MILITARY CONSTRUCTION**



**ENGINEERING:
FAMILY HOUSING**



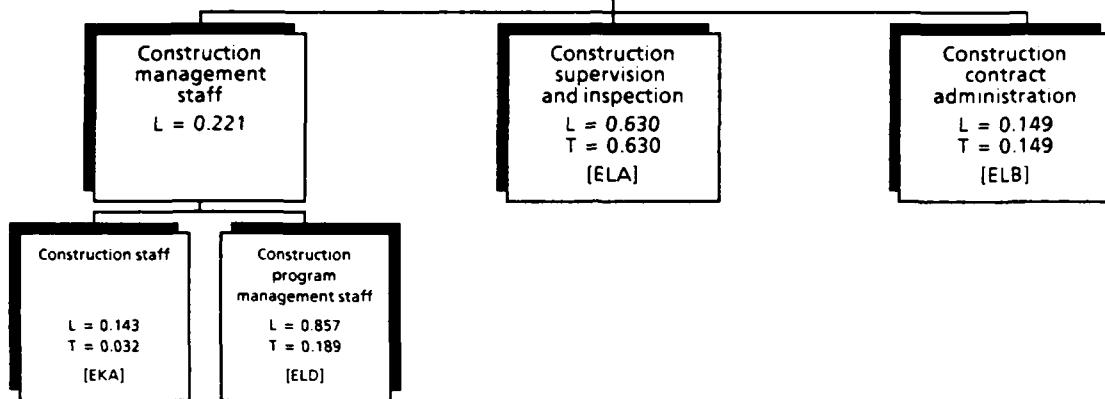
**ENGINEERING:
OPERATIONS & MAINTENANCE**



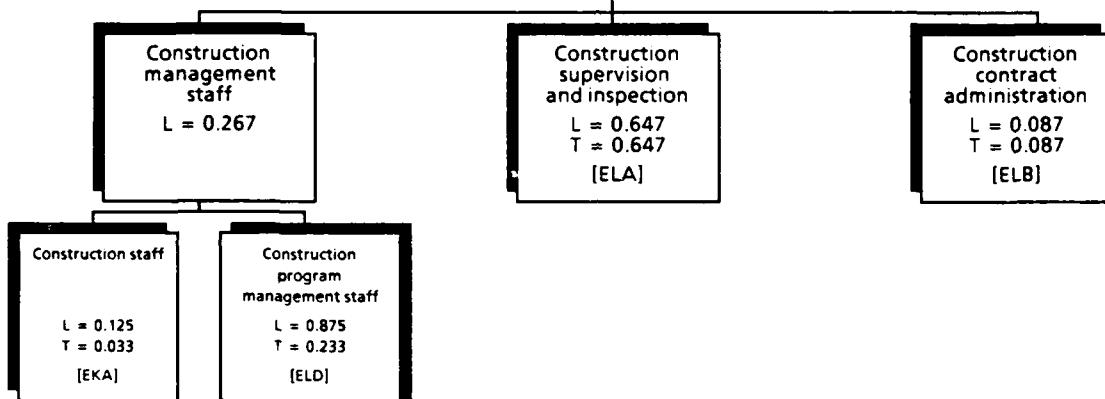
Note: L = Level coefficient of relative usage; T = Total coefficient of relative usage.

**FIG. B-1. STANDARD WORK CENTER CODES OF THE ARMY FUNCTIONAL DICTIONARY FOR USACE
MILITARY MANPOWER ACCOUNTING - ENGINEERING TREES**

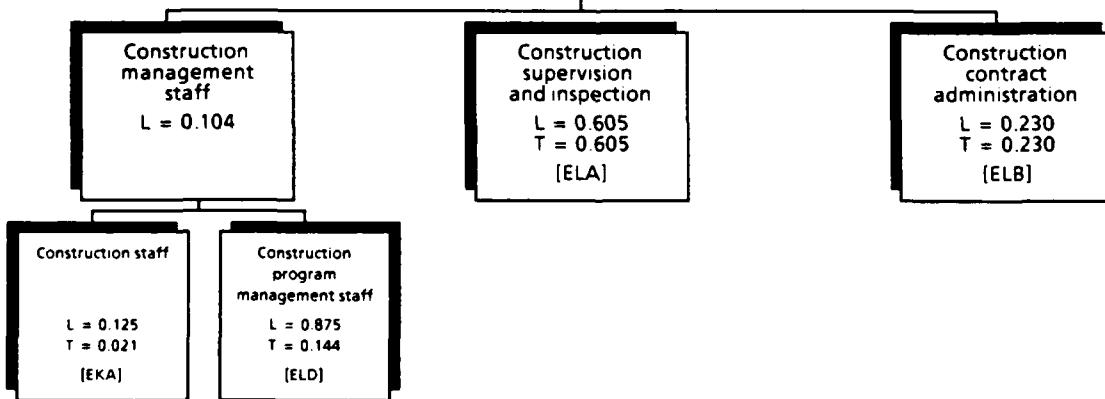
**CONSTRUCTION:
MILITARY CONSTRUCTION**



**CONSTRUCTION:
FAMILY HOUSING**

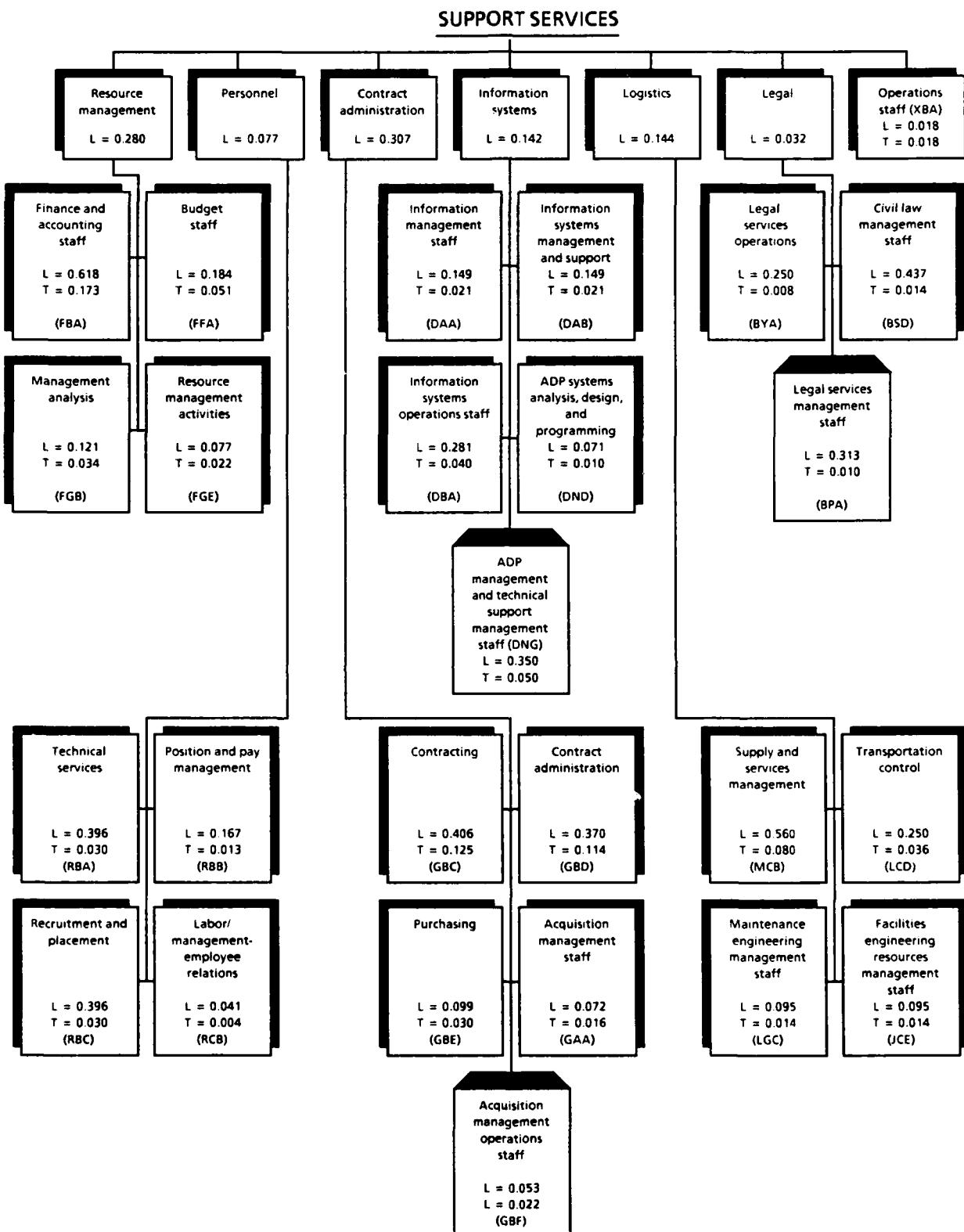


**CONSTRUCTION:
OPERATIONS & MAINTENANCE**



Note: L = Level coefficient of relative usage; T = Total coefficient of relative usage

**FIG. B-2. STANDARD WORK CENTER CODES OF THE ARMY FUNCTIONAL DICTIONARY
FOR USACE MILITARY MANPOWER ACCOUNTING – CONSTRUCTION TREES**



Note: L = Level coefficient of relative usage; T = Total coefficient of relative usage.

**FIG. B-3. STANDARD WORK CENTER CODES OF THE ARMY FUNCTIONAL DICTIONARY FOR USACE
MILITARY MANPOWER ACCOUNTING – SUPPORT SERVICES TREE**

within the scope of this project to conduct engineering studies or make other direct observations to determine relative manpower requirements. Such studies, to be valid, would be prohibitively expensive and difficult to design and conduct. They would have to cover all types of work, in all types of USACE district offices, over several years. Neither was it possible to conduct statistical analyses of historical data, because the USACE accounting system does not capture this type of information.

We chose a methodology called the Analytic Hierarchy Process (AHP) to determine relative manpower requirements by AFD categories. AHP is an objective procedure that assists a group of people in ranking a set of factors. As part of the ranking process, AHP calculates the relative weight of each factor compared to all other factors. We used AHP with specially selected panels of experienced USACE personnel to discuss and formulate the relative usage of manpower in AFD categories for various types of USACE work. To facilitate the process, we used a personal computer software implementation of AHP called Expert Choice.¹

EXPERT CHOICE

USACE Headquarters staff selected panels of manpower experts to participate in the AHP/Expert Choice sessions. Groups of experts were selected from all three areas: engineering, construction, and support services. LMI project team members served as facilitators at three 1-day sessions in which the tree structures were discussed and analyzed. The process for each panel was as follows:

- The panel first reviewed and discussed each SWCC definition to ensure that all types of USACE district office work activities were adequately covered by a single code for each function. Some adjustments were made to the tree structures based on these reviews.
- Beginning at the top level of the tree, the panel used Expert Choice software to determine the relative manpower usage of each work center (as defined by the SWCCs) in performing activities related to the particular type of USACE work under consideration (e.g., military construction).
- The panel then moved down to the next level in the tree. At the second level, the panel determined the relative manpower usage of the related subunits as a proportion of the total manpower for the work center they comprise. For example, finance and accounting staff, budget staff, management analysis,

¹Copyrighted by Decision Support Software, Inc., McLean, VA. 1983.

and resource management activities are the four subunits comprising the resource management work center within support services.

- The engineering and construction panels repeated the exercise for three major types of USACE workload: military construction, operations maintenance, and family housing. For support services, the expert panel believed that the same set of weights would apply to all types of work.

The Expert Choice panels produced relative weights that will be used in the CERAMMS model to project district manpower requirements by SWCC for each type of USACE work. These relative weights, or coefficients, are listed in Table B-1. The CERAMMS manpower estimate for each category (engineering, construction, and support services) will be multiplied by these coefficients to generate manpower estimates for each SWCC.

The Expert Choice software produces an Inconsistency Ratio as a quantitative measure of the consistency of the groups comparisons among SWCC. All three USACE expert panels yielded inconsistency ratios that were well below the population norm for judgmental comparisons of this type. In addition, each panel reviewed the final results and felt that the weights were indeed a fair representation of reality. Therefore, we believe that the weights determined by the expert panels and the Expert Choice process can reliably be used as coefficients in the CERAMMS manpower model.

The final CERAMMS coefficients in Table B-1 were generated by a two-step process. Expert Choice produces a set of coefficients that sum to one at each level in the hierarchy tree (i.e., *level* coefficients). For SWCCs at the first level of a tree, the *total* (CERAMMS) coefficient was equal to the *level* coefficient. For SWCCs at the second level of a tree, the *total* coefficient was equal to the product of the two relevant *level* coefficients.² The *total* coefficients sum to one for the entire tree. The *level* and *total* coefficients associated with each tree are included in Figures B-1 through B-3.

²Second-level coefficients for legal and information management SWCCs were estimated based on the MOC data, since the Expert Choice panel for support services did not include anyone representing these functions.

TABLE B-1
COEFFICIENTS FOR DISAGGREGATION OF CERAMMS ESTIMATES BY SWCC

CERAMMS category and AFD title	SWCC ^a	Military construction	Family housing	Operations and maintenance
Engineering				
Engineering operations staff	ECA	0.412	0.294	0.431
General engineering	ECB	0.040	0.034	0.078
Electrical and mechanical engineering	ECC	0.103	0.102	0.138
Geo-technical engineering	ECD	0.148	0.162	0.037
Civil/environmental engineering	ECF	0.049	0.080	0.035
Structural engineering operations	EDB	0.195	0.272	0.230
Master planning	EEA	0.017	0.018	0.021
Engineering management activities	EFA	0.036	0.038	0.030
		1.000	1.000	1.000
Construction				
Construction staff	EKA	0.032	0.033	0.021
Construction supervision and inspection	ELA	0.630	0.647	0.605
Construction contract administration	ELB	0.149	0.087	0.230
Construction program management staff	ELD	0.189	0.233	0.144
		1.000	1.000	1.000
Support Services				
Legal services management staff	BPA	0.010	0.010	0.010
Civil law management staff	BSD	0.014	0.014	0.014
Legal services operations	BYA	0.008	0.008	0.008
Information management staff	DAA	0.021	0.021	0.021
Information systems management and support	DAB	0.021	0.021	0.021
Information systems operations staff	DBA	0.040	0.040	0.040
ADP systems analysis, design, and programming	DND	0.010	0.010	0.010
ADP mgt. and technical support mgt. staff	DNG	0.050	0.050	0.050
Finance and accounting staff	FBA	0.173	0.173	0.173
Budget staff	FFA	0.051	0.051	0.051
Management analysis	FGB	0.034	0.034	0.034
Resource management activities	FGE	0.022	0.022	0.022
Acquisition management staff	GAA	0.022	0.022	0.022
Contracting	GBC	0.125	0.125	0.125
Contract administration	GBD	0.114	0.114	0.114
Purchasing	GBE	0.030	0.030	0.030
Acquisition management operations staff	GBF	0.016	0.016	0.016
Facilities engineering resources mgt. staff	JCE	0.014	0.014	0.014
Transportation control	LCD	0.036	0.036	0.036
Maintenance engineering management staff	LGC	0.014	0.014	0.014
Supply and services management	MCB	0.080	0.080	0.080
Technical services	RBA	0.030	0.030	0.030
Position and pay management	RBB	0.013	0.013	0.013
Recruitment and placement	RBC	0.030	0.030	0.030
Labor/management employee relations	RCB	0.004	0.004	0.004
Operations staff	XBA	0.018	0.018	0.018
		1.000	1.000	1.000

^a SWCCs are defined in Appendix C.

APPENDIX C

SWCC DEFINITIONS

BPA – *Legal Services Management Staff.* Staff-type work center involved in formulation and execution of plans, programs, policies, and procedures for legal services management. Includes long-range planning; program coordination, oversight, and evaluation; and advisory services. Also includes common staff responsibilities internal to the work center.

BSD – *Civil Law Management Staff.* Work center involved in the provision of legal advice and representation in all aspects of acquisition law, litigation, labor law and labor counseling, regulatory law, and environmental law.

BYA – *Legal Services Operations.* Work center involved in management, operation, and delivery of legal services, including all aspects of civil law, military law, and claims. Includes legal advice in all areas of law, administration of military justice, administrative support to military judiciary, legal support for litigation involving the Department of the Army, and assistance to other Government legal agencies.

DAA – *Information Management Staff.* Staff-type work center involved in formulation and execution of plans, programs, policies, and procedures for information management. Includes long-range planning; program coordination, oversight, and evaluation; and advisory services. Also includes common staff responsibilities internal to the work center.

DAB – *Information Systems Management and Support.* Work center involved in management assistance and support of information management systems, including data automation resources and operations; communications activities, including installation and field telecommunications systems, air traffic control and command and control networks; audiovisual system support; electronic mail technology; information systems architecture design and control; software development, support and maintenance; information management systems, including operational, administrative and other systems; and the integration and compatible interface of various functional or mission-oriented information systems.

DBA – *Information Systems Operations Staff.* Staff-type work center involved in formulation and execution of plans, programs, policies, and procedures for information system operations. Includes long-range planning; program coordination, oversight, and evaluation; and advisory services. Also includes common staff responsibilities internal to the work center.

DND – *Automatic Data Processing Systems Analysis, Design, and Programming.* Work center involved in computer programming in support of information systems and system applications. Includes analysis and implementation of new systems and applications programs, review and analysis of existing systems and applications programs, evaluation of various programming methods and procedures, and initial test and ongoing maintenance of computer programs.

DNG – *ADP Management and Technical Support Management Staff.* Work center involved in management of data processing functions, including computer operations, unit-level maintenance elements, and data processing technical support activities such as production control, database management, data codes, and tape/disk libraries. Includes development of equipment, communication, and environmental support plans for data processing systems.

ECA – *Engineering Operations Staff.* Staff-type work center involved in formulation and execution of plans, programs, policies, and procedures for engineering operations. Includes long-range planning; program coordination, oversight, and evaluation; and advisory services. Also includes common staff responsibilities internal to the work center.

ECB – *General Engineering.* Work center involved in relocations, cost estimating, sanitary engineering, recreational facility design, mapping, surveying, remote sensing, and military and foreign assistance programs.

ECC – *Electrical and Mechanical Engineering.* Work center involved in electrical and mechanical engineering aspects of planning, design, construction, and operation phases of projects, including installation and testing of electrical and mechanical equipment.

ECD – *Geo-technical Engineering.* Work center involved in the development of technical standards for engineering geology and rock/soil mechanics; embankment and excavated slope stability; earthquake engineering; under-seepage, settlement, drainage, earth pressures, and slope protection; and other geo-technical engineering subjects. Includes geological/geophysical investigation, grouting technology, riprap and armor stone quality and sources, tunnels and special excavations, dewatering, and ground effects of seismic events.

ECF – *Civil/Environmental Engineering.* Work center involved in the development of civil and environmental engineering criteria; policy and standards for military construction; and review of road, railroad, port, airfield, storage facility, and land survey program requirements.

EDB – *Structural Engineering Operations.* Work center involved in structural, architectural, and related design and engineering; preparation of study, concept, and design proposals; and review and approval of heating,

ventilation, water distribution, plumbing, refrigeration, fire protection, and other system designs.

EEA – *Master Planning.* Work center involved in development and maintenance of installation master plans and mobilization construction plans; development of military construction programs and associated budget documentation; and technical coordination for the planning/programming, design, and execution phases of military construction projects. Also includes liaison with district engineer for master planning, military construction project design, and technical support.

EFA – *Engineering Management Activities.* Work center involved in the management and control of general, military, electrical, mechanical, geo-technical, hydraulic, civil or environmental, and structural engineering.

EKA – *Construction Staff.* Staff-type work center involved in formulation and execution of plans, programs, policies, and procedures for construction. Includes long-range planning; program coordination, oversight, and evaluation; and advisory services. Also includes common staff responsibilities internal to the work center.

ELA – *Construction Supervision and Inspection.* Work center involved in surveillance of construction projects, collection of engineering and design technical data, conduct of constructional reviews prior to contract award, inspection of ongoing construction, and documentation for transfer of completed work to appropriate agency.

ELB – *Construction Contract Administration.* Work center involved in administration of contract construction work, technical assistance in contract negotiations, and preparation of construction contracts and modifications.

ELD – *Construction Program Management Staff.* Work center involved in management of construction programs, construction and inspection contract compliance, and administration and technical control of construction contract work.

FBA – *Finance and Accounting Staff.* Staff-type work center involved in formulation and execution of plans, programs, policies, and procedures for finance and accounting. Includes long-range planning; program coordination, oversight, and evaluation; and advisory services. Also includes common staff responsibilities internal to the work center.

FFA – *Budget Staff.* Staff-type work center involved in formulation and execution of plans, programs, policies, and procedures for budget. Includes long-range planning; program coordination, oversight, and evaluation; and advisory services. Also includes common staff responsibilities internal to the work center.

FGB – *Management Analysis*. Work center involved in review and analysis of methods and procedures; personnel, facility, and equipment utilization; organizational structure and workload distribution; and standard measures of economy and efficiency.

FGE – *Resource Management Activities*. Work center involved in analysis, improvement, and overall management of organizational funds, manpower, equipment, property, and facilities; methods and standards of performance; analysis of costs as applied to specific programs or systems; and measurement and improvement of personnel productivity.

GAA – *Acquisition Management Staff*. Staff-type work center involved in formulation and execution of plans, programs, policies, and procedures for acquisition management. Includes long-term planning; program coordination, oversight, and evaluation; and advisory services. Also includes common staff responsibilities internal to the work center.

GBC – *Contracting*. Work center involved in the execution of formal binding contracts between the U.S. Government and private suppliers of commodities and services, including preparation of contract; preparation of determinations and findings; securing approval of determinations and findings; negotiation/renegotiation of contracts and agreements; and issuance of delivery orders.

GBD – *Contract Administration*. Work center involved in administration of contracts to ensure compliance with contractual requirements; coordination and processing of payment requests; maintenance of contract files; processing requests for modification in content, deliverables, and schedules; closeout of completed or terminated contracts; evaluation of contract or compliance; and processing of damage claims against contractors on GOCO equipment, cargo, and other materiel.

GBE – *Purchasing*. Work center involved in the acquisition of supplies, services, or construction valued at less than \$25,000. Includes purchase and delivery orders, imprest fund transactions, and other documents.

GBF – *Acquisition Management Operations Staff*. Work center involved in the management of purchasing and contracting for systems, assemblies, components, parts, materials, supplies, utilities, construction, and services for use by military activities and contractors. Including source selection, contracting, contract administration, and price and cost analysis.

JCE – *Facilities Engineering Resources Management Staff*. Work center involved in the management and control of resources in connection with real property facilities construction, operation, and maintenance. Activities include programming, coordinating, and scheduling resources for accomplishing work; preparation of real property maintenance reports; operation of the work management system; assets accounting; analysis of completed work

and shop performance; providing industrial engineering services and expertise in developing standards and methods for improving performance and productivity; and providing programming/budgetary and fiscal guidance to engineering staff and operating elements.

LCD – *Transportation Control.* Work center involved in the control of transportation engineering; quality control military air traffic coordination; personnel property; personnel movements; freight/cargo transportation; and motor transportation services, railroad operation, and utility watercraft operations.

LGC – *Maintenance Engineering Management Staff.* Work center involved in formulation of maintenance concepts, plans, and programs in support of all phases of materiel systems development. Includes development of the maintenance aspects of the total logistic support systems, analysis of the systems and procedures designed to improve maintenance engineering and operations, assistance to field units in resolution of maintenance problems, development of maintenance support parameters and guidance, coordination of maintenance program requirements during developmental and operational test and evaluation phases of system development, evaluation and identification of calibration requirements, management of configuration status and engineering change accounting system programs during preissue phase of system development and subsequent to system deployment, collection and analysis of materiel performance and maintenance work force performance data for use in setting system support limits and identification of areas requiring engineering actions, product improvement engineering, and preparation of maintenance publications based upon collection and use of technical data. Also includes new equipment training programs accounted for in the training and evaluation category.

MCB – *Supply and Services Management.* Work center involved in the management and control of installation supply; establishment and maintenance of requisitioning objectives and authorized in-stock list based on demand criteria, mission essentiality, or standby requirements. Includes purifying stock in order to identify and declare excess material and taking action to reposition for other requirements, maintaining adequate property stock on hand by initiating replenishment requisitions at the least possible cost within funding limitations, and avoiding undue accumulation of excesses. Includes administering of installation supply activity accountable records. One chief is the accountable property officer. Activities involved in the provision of technical assistance and logistical support pertain to supply support, including the direct support system, reserve component supply, and central issue facilities. Provides assistance by means of customer liaison and assistance teams on scheduled basis or on notice, assists customers in purifying supply and storage records, completes location surveys, establishes location systems, takes inventories, identifies and turns in excess items, and trains unit personnel. Also includes researching and

evaluating customer problems, recommending corrective action, and assisting customer in the delivery and pickup of material. Activities involved in the management and control of food services, laundry and dry cleaning, and mortuary affairs.

RBA – *Technical Services.* Work center involved in the administration of civilian personnel support functions. Includes initiation and processing of actions and changes affecting employee status, pay, and benefits; administration of civilian suggestion, incentive award, and benefits programs; conduct of internal evaluations; management of civilian personnel information/reporting systems; and maintenance of personnel records.

RBB – *Position and Pay Management.* Work center involved in the management of civilian personnel positions and pay, including establishment, revision, and deletion of positions; implementation of new classification standards; review of requests for personnel actions, including recruitment; conduct of biennial reviews of organization's positions; employee counseling on classification complaint and appeal procedures; performance of audits resulting from formal complaints; processing of formal appeals and labor court cases; evaluation of impacts of individual position actions and reorganizations; performance of position control activities; wage surveys to determine population characteristics; and collection of wage data for determination of environmental pay and work allowances.

RBC – *Recruitment and Placement.* Work center involved in the recruitment, placement (including career management), and separation of civilian employees; development and implementation of plans and programs to provide emphasis on special employment and utilization programs; performance of vacancy fill actions; training/orientation of installation employees; and other personnel actions.

RCB – *Labor/Management-Employee Relations.* Work center involved in local labor/management negotiations and relations, disciplinary and adverse actions, grievances and appeals in support of management-employee communications/relations, alcohol and drug control, equal employment opportunity programs, and evaluation of effectiveness of civilian personnel offices.

XBA – *Operations Staff.* Staff-type work center involved in formulation and execution of plans, programs, policies, and procedures for operations. Includes long-range planning; program coordination, oversight, and evaluation; and advisory services. Also includes common staff responsibilities internal to the work center.